

summing in-phase and quadrature phase parts of the output signal outputted from a plurality of blocks as

$$\left(\sum_{n=1}^K ((W_{M,n1}X_{n1} + jW_{M,n2}X_{n2}) \times (W_{M,n3} + jW_{M,n4})) \right), K \text{ is a predetermined integer}$$

greater than or equal to 1 to generate I channel and Q channel signal.

~~42.~~ The method of claim ~~41~~ wherein a spreading code spreads the summed in-phase and quadrature-phase signals outputted from the summing step.

~~43.~~ The method of claim ~~41~~ wherein said orthogonal code sequence includes a Hadamard code sequence.

~~44.~~ The method of claim ~~41~~ wherein said orthogonal code sequence includes a Walsh code.

~~45.~~ The method of claim ~~42~~ wherein said spreading code is one spreading code.

~~46.~~ The method of claim ~~45~~ wherein said spreading code sequence includes a PN code.

~~47.~~ The method of claim ~~45~~ wherein said spreading code includes a first spreading code for the in-phase signal and a second spreading code for the quadrature-phase signal.

~~48.~~ The method of claim ~~47~~ wherein the first and second spreading codes are PN codes.

~~49.~~ The method of claim ~~43~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,13}=W_0$, $W_{M,14}=W_1$, when $M=4$.

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50. The method of claim ⁹49 wherein $M=8$ and $W_{M,12}=W_4$.

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51. The method of claim ³43 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, where p represents a predetermined number in a range from 0 to $(M/2)-1$, and $W_{M,n3}=W_{2n-2}$, $W_{M,n4}=W_{2n-1}$.

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52. The method of claim ³43 wherein $W_{M,21}=W_0$, $W_{M,22}=W_4$, $W_{M,23}=W_2$, $W_{M,24}=W_3$ when $M=8$ in case of two channels.

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53. The method of claim ¹²52 wherein $W_{M,12}=W_6$, and $W_{M,22}=W_6$.

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54. An orthogonal complex spreading apparatus, comprising:
a plurality of complex multiplication blocks, each for complex-multiplexing a complex signal $W_{M,n1}X_{n1} + j W_{M,n2}X_{n2}$ by $W_{M,n3} + j W_{M,n4}$ wherein $W_{M,n1}X_{n1}$ is obtained by multiplying an orthogonal code sequence $W_{M,n1}$ by first data group X_{n1} of n -th block and $W_{M,n2}X_{n2}$ is obtained by multiplying orthogonal sequence $W_{M,n2}$ by second data group X_{n2} of the n -th block, wherein M and n are positive integers and $W_{M,n1}$, $W_{M,n2}$, $W_{M,n3}$ and $W_{M,n4}$ are predetermined orthogonal sequences; and

a summing unit for summing in-phase and quadrature phase parts of an output signal from each block of the plurality of the complex multiplication blocks as

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$$\left(\sum_{n=1}^K ((\alpha_{n1} W_{M,n1} X_{n1} + j \alpha_{n2} W_{M,n2} X_{n2}) \times (W_{M,n3} + j W_{M,n4})) \right), K \text{ is a predetermined integer}$$

greater than or equal to 1.

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55. The apparatus of claim ¹⁴54 further comprising a spreading unit for multiplying the summed in-phase and quadrature phase signals inputted from the summing unit by spreading code.

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56. The apparatus of claim ¹⁵55 wherein said spreading unit multiplies the in-phase and quadrature phase part by different spreading codes.

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57. The apparatus of claim 14 wherein each said complex multiplication block includes:

a first multiplier for multiplying the first data group X_{n1} by the orthogonal code sequence $W_{M,n1}$;

a second multiplier for multiplying the second data group X_{n2} by the orthogonal code sequence $W_{M,n2}$;

third and fourth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n3}$;

fifth and sixth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n4}$;

a first adder for subtracting output signal from the sixth multiplier from output signal (ac) from the third multiplier and outputting an in-phase information; and

a second adder for summing output signal from the fourth multiplier and output signal from the fifth multiplier and outputting quadrature phase information.

58. The method of claim 57 wherein said orthogonal code sequence includes a Hadamard code sequence.

59. The method of claim 57 wherein said orthogonal code sequence includes a Walsh code.

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²⁵₆₅. The method of claim ²³₆₃ wherein $W_{M,I}=W_0$, $W_{M,Q}=W_{2q+1}$ (where q represents a predetermined number in a range from 0 to $(M/2)-1$).

²⁶₆₆. The method of claim ²³₆₃ further comprising the steps of:
multiplying the first data group X_{n1} by gain α_{n1} ; and
multiplying the second data group X_{n2} by gain α_{n2} .

²⁷₆₇. The method of claim ²³₆₃ wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when $M=4$.

²⁸₆₈. The method of claim ²⁷₆₇ wherein $M=8$ and $W_{M,12}=W_4$.

²⁹₆₉. The method of claim ²³₆₃ wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2q+1}$, wherein q represents a predetermined number in a range from 0 to $(M/2)-1$ and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

³⁰₇₀. The method of claim ²⁰₆₀ wherein each group has at least two channels and the receiving step includes the steps of:

summing output signals $W_{M,n1}X_{n1}$ from a first sequence multiplier; and
summing output signals $W_{M,n2}X_{n2}$ from a second sequence multiplier.

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21. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels to first and second groups, comprising:

a first multiplier block having at least one channel contained in a first group of channels, each for outputting $W_{M,n1}X_{n1}$ which is obtained by multiplying first data group X_{n1} by orthogonal code sequence $W_{M,n1}$, M and n are positive integers;

a second multiplier block having a number of channels having at least one channel contained in a second group of channels, each for outputting $W_{M,n2}X_{n2}$ which is obtained by multiplying a first data group X_{n2} by orthogonal code sequence $W_{M,n2}$;

a complex multiplier for receiving the output signals from the first and the second multiplier blocks in a complex form of

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$$\sum_{n=1}^K (W_{M,n1}X_{n1} + jW_{M,n2}X_{n2}) \text{ and complex-multiplying received output}$$

signal by $W_{M,I} + jPW_{M,Q}$, wherein $W_{M,I}$ and $W_{M,Q}$ are predetermined

orthogonal code sequence permuted and P is a predetermined sequence.

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~~72.~~ The apparatus of claim ~~71~~ wherein said orthogonal code sequence includes a Hadamard code sequence.

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73. The apparatus of claim 71 wherein said orthogonal code sequence includes a Walsh code.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when $M=8$ in case of three input channels.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of three input channels.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of four input channels.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of four input channels.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_1$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five input channels.

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The apparatus of claim ~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_3$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five channels.

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The apparatus of claim ~~71~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,22}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of five input channels.

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~~81.~~ The apparatus of claim ³⁶~~76~~ wherein $W_0X_{11} + jW_4X_{12}$, W_2X_{21} and W_6X_{31} are replaced by $\alpha_{11}W_0X_{11} + j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_2X_{21}$ and $\alpha_{31}W_6X_{31}$, and a gain α_{n1} and a gain α_{n2} are the identical gain in order to remove the phase dependency by an interference occurring in a multipath of a self signal and an interference occurring by other users.

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~~82.~~ The apparatus of claim ³¹~~71~~ wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

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~~83.~~ The apparatus of claim ³¹~~71~~ wherein the first multiplier block comprises at least a third multiplier for multiplying the first data group X_{n1} by gain α_{n1} , and the second multiplier block comprises at least a fourth multiplier the second data group X_{n2} by gain α_{n2} .

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~~84.~~ The apparatus of claim ³²~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$, when $M=8$ in case of two input channels.

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~~85.~~ The apparatus of claim ³²~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$, when $M=8$ in case of three input channels.

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~~86.~~ The method of claim ³⁵~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$, when $M=8$ in case of two input channels.

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~~87.~~ The apparatus of claim ³²~~72~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, $W_{M,21}=W_4$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$, when $M=8$ in case of three input channels.

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88. The apparatus of claim 71 wherein each group has at least the two input channels, further comprising:

a first adder for outputting

$$\sum_{n=1}^N (W_{M,nl} X_{nl})$$
 by summing output signals from the first multiplier block; and

a second adder for outputting

$$\sum_{n=1}^K (W_{M,n2} X_{n2})$$
 by summing output signals from the second multiplier block.

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~~89.~~ The apparatus of claim ~~71~~ further comprising:

a spreading unit for multiplying the signal

$$\sum_{n=1}^N (W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$$
 received by the complex multiplier by a spreading code.

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90. The apparatus of claim 89 wherein the spreading unit respectively multiplies the in-phase and quadrature-phase parts by different spreading codes.

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~~9~~1. The apparatus of claim ~~7~~ wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences.

fifth and sixth multipliers for multiplying said output signal from the first multiplier block and said output signal from the second sequence multiplier by orthogonal sequence W_{ML} ;

a third adder for subtracting output signal from the eighth multiplier from output signal from the fifth multiplier to output an in-phase information; and

33. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels into first and second groups, comprising:

a complex multiplier for receiving the output signals $W_{M,n1} X_{n1}$ and $W_{M,n2} X_{n2}$ from

$$\sum_{n=1}^K (W_{M,n1} X_{n1} + j W_{M,n2} X_{n2})$$
 and multiplying a received signal

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The apparatus of claim 93 wherein each group has at least two input channels, further comprising:

a first adder for outputting

$\sum_{n=1}^K (W_{M,n1} X_{n1})$ by summing output signals from the first sequence multiplier; and

a second adder for outputting

$\sum_{n=1}^K (W_{M,n2} X_{n2})$ by summing output signals from the second sequence multiplier.

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The apparatus of claim 93 wherein the first sequence multiplier comprises at least one first gain multiplier for multiplying the data X_{n1} of each channel of the first group by gain α_{n1} , and the second sequence multiplier comprises at least one second gain multiplier for multiplying the data X_{n2} of each channel of the second group by gain α_{n2} .

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The apparatus of claim 93 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, where p represents a predetermined integer in a range from 0 to $(M/2)-1$.

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The apparatus of claim 93 wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences. --

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